DCOI's favorable environmental profile during treatment and in-service use

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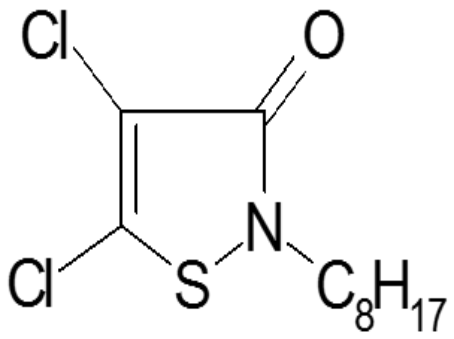
Agenda

- Isothiazolinone chemistries
- DCOI proven track record
- Environmental Performance
- Summary and Conclusion

Dichloro-octyl-isothiazolinone (DCOI)



- **4,5-Dichloro-2-octylisothiazol-3(2H)-one (DCOI)**
- **CAS: 64359-81-5**
- **Broad-spectrum antimicrobial activity**
  - **includes fungi, algae & bacteria**

DCOI: enduring regulatory performance




Approved for use under US EPA and EU Biocidal Products Regulation (EC)528/2012

US EPA: Active substance first approved in 1983

EU BPR Approved as wood preservative in 2008

(national approvals in EU countries since late 1990's)

Wide range of uses:

Wood preservation

Marine antifouling. US Presidential Green Chemistry Award in 1996

Cooling tower: algaecide

Paints and coatings: control of mold and mildew.

GREEN CHEMISTRY

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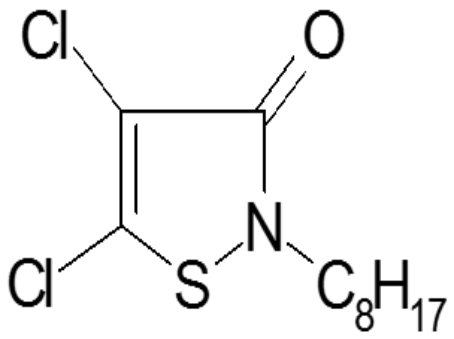
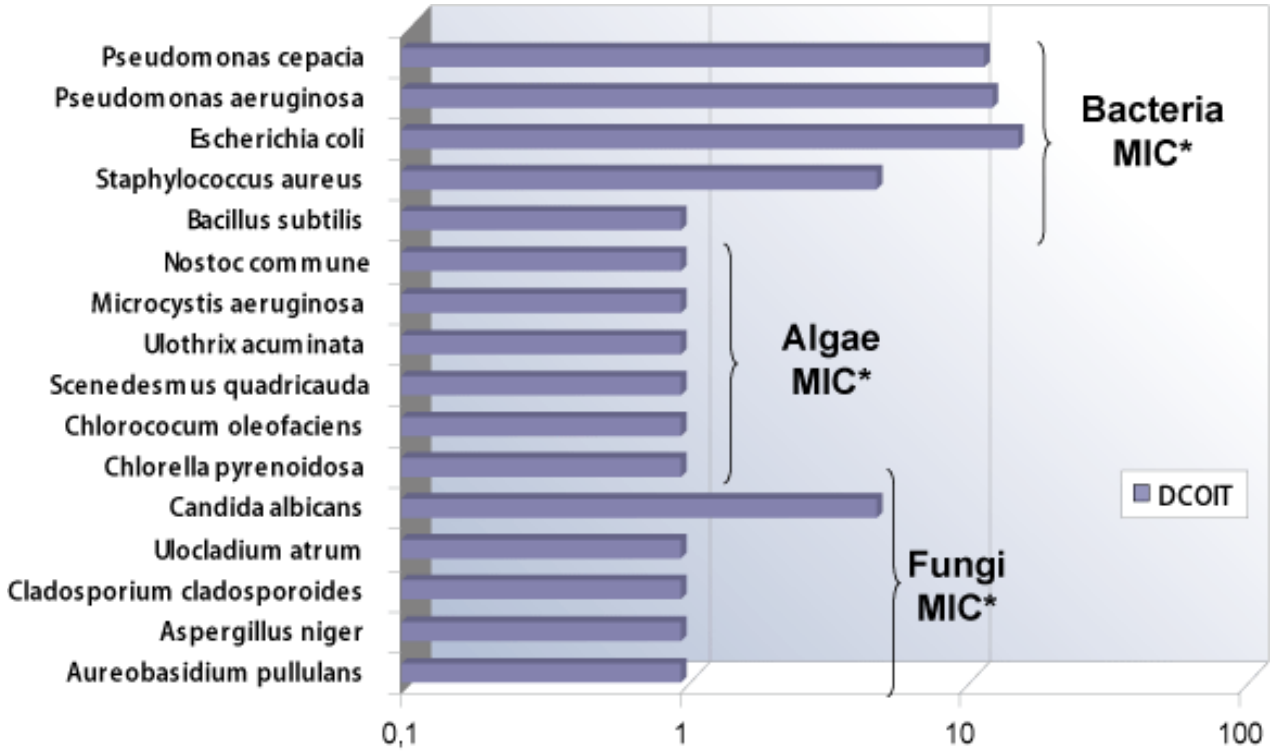
Dichloro-octyl-isothiazolinone (DCOI)



- **EFFECTIVE PERFORMANCE- DOES THE JOB:**
  - **Broad spectrum** activity; extremely **low leaching**:
- **RAPIDLY ELIMINATED- GOES AWAY:**
  - **Quickly biodegraded** (not “persistent”)
  - Easily detoxified (ring-opening) and biodegradable
- **LEAVES NO SIGNIFICANT ENVIRONMENTAL IMPACT**
  - **Not bioaccumulating**
  - **Not a “priority substance**” for water policies
  - **Low mobility** in soil and effective mineralisation

DCOI: environmentally sustainable performance

- **Performance and Endurance:**
  - Non-metals-based organic chemistry
  - Broad-spectrum: algaecide fungicide and bactericide, long lasting performance
  - very low water solubility (<5 ppm)
  - low leaching, high substantivity
  - UV-stable
  - Low volatility from treatment systems or in use
  - **System Compatibility**



DCOI: Environmental profile in soil

- **Biodegrades quickly in soil and dissipates through removal mechanisms**
- DCOI demonstrates degradation half-lives in soil between 12 and 48h @ 42-77 deg F*. Dissipation, consisting of primary degradation, adsorption of non-extractable breakdown products to organic matter and subsequent mineralization, was characterised with a half life under 5 days.
- Soil mobility: Organic carbon/water adsorption coefficient (Kaoc) is high (mean Kaoc = 6600), indicating that (DCOI and) degradates bind strongly to soil and sediment. Mobility and transport into environmental waters is consequently very low, with corresponding low risk of groundwater contamination.
- Incorporation into humic fraction and ultimate mineralization occurs at natural rates. Dioxins, furans were not detected.
- *Results of simulation studies. Ready biodegradability studies are not suited to many biocidal actives

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DCOI: Environmental profile in water/sediment systems

- **DCOI biodegrades very quickly in water and dissipates through removal mechanisms into sediment**
- DCOI biodegradation half lives in fresh and estuarine water are from 3 hours to 1.5 days. In studies, parent compound despite rapid partitioning, was not detected in sediment. Dissipation from environmental water/sediment systems is by primary degradation and subsequent absorption and mineralization of breakdown products
- Groundwater contamination risk is considered negligible due to
  - Rapid partitioning to soil/sediment and irreversible binding to solid matter
  - Degradation, lower inherent toxicity of breakdown products, mineralization
- The Bioconcentration Factor (BCF) is assessed as low: does not bioaccumulate
- DCOI at high dilution will behave similarly in wastewater treatment facilities

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DCOI Biodegradates

- Biological process (reactivity at the Sulphur-Nitrogen bond and cleavage of the isothiazolinone ring) drives the degradation process. Critical degradates characterized

N-(n-octyl) malonamic acid (NNOMA)	**N-(n-octyl)acetamide (NNOA)**
N-(n-octyl) oxamic acid (NNOOA)	**2-chloro-2-(n-octyl carbamoyl)-1-ethene sulfonic acid**

- Lower orders of magnitude of toxicity (2-5X) than parent. Toxicity to earthworms in DCOI treated soil systems shows environmental concentrations of no concern.
- Both NNOMA, NNOA are readily biodegradable. In addition structural activity relationship (SAR) assessment) predicts NNOOA and the sulfonic acid breakdown product will similarly biodegrade.
- Simulation studies demonstrate that degradates are tightly bound to soil/sediment
  - Non-mobile, do not migrate
  - Full mineralization occurs at natural rates: incorporation into humic fraction

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Key Benefits

- Global approvals
- Highly effective, extended performance broad-spectrum preservative
- Organic molecule non-metal-based; Rapid degradation in biotic systems
- Effective and non-extractable binding reduces bioavailability and environmental toxicity
- Breakdown products lower toxicity and removed through mineralization
- Non-persistent no water framework priority; non bio-accumulative in the food chain
- Absence of systemic toxicity; no dioxin generation
- Dilute concentrations removed through Wastewater treatment plants

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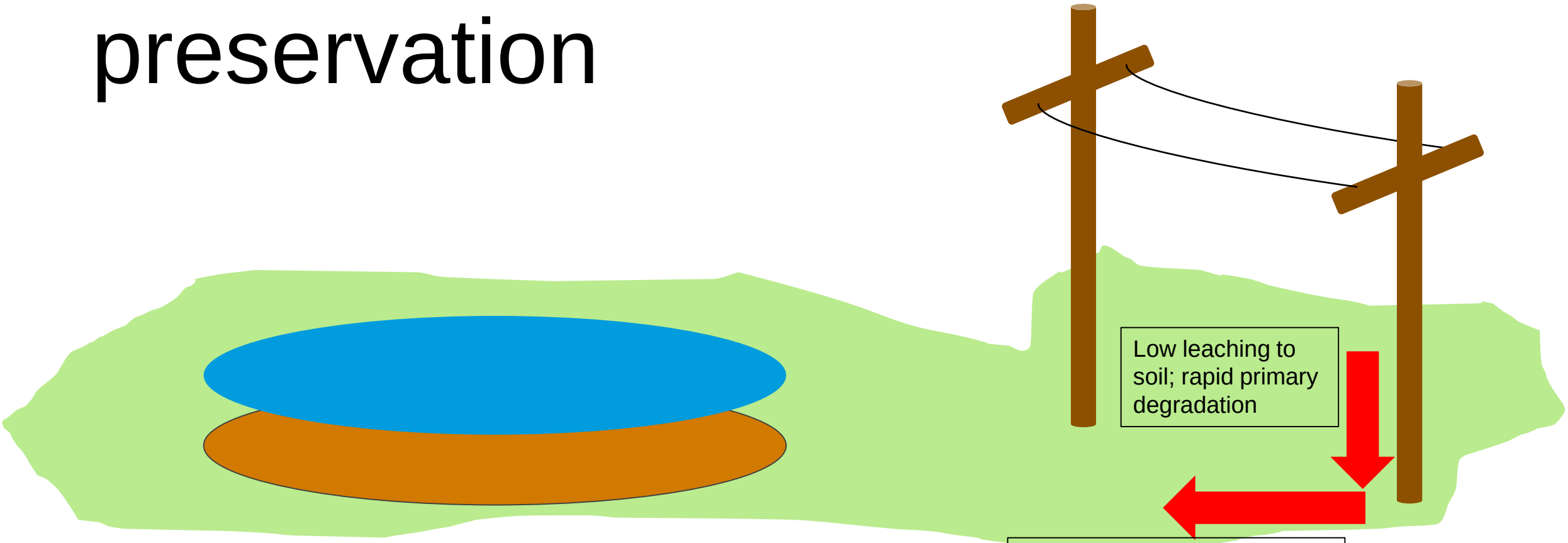
DCOI: today's choice for environmentally sustainable wood preservation



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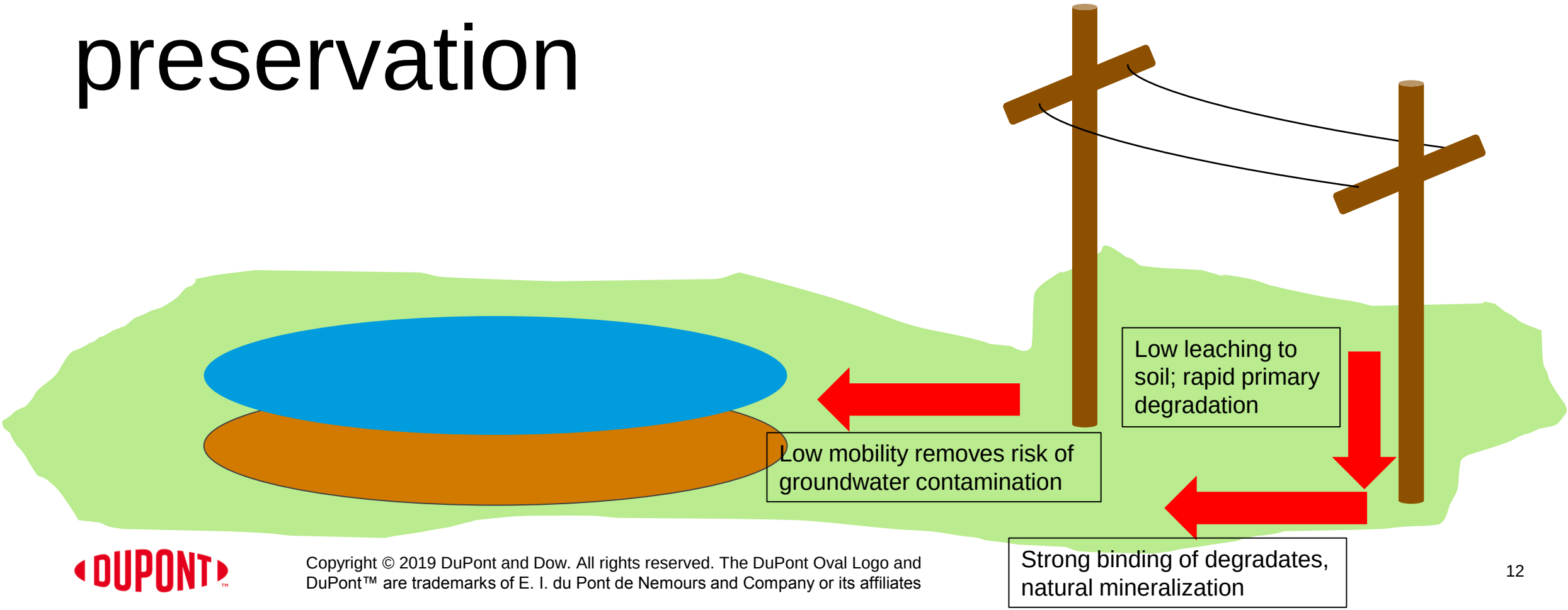

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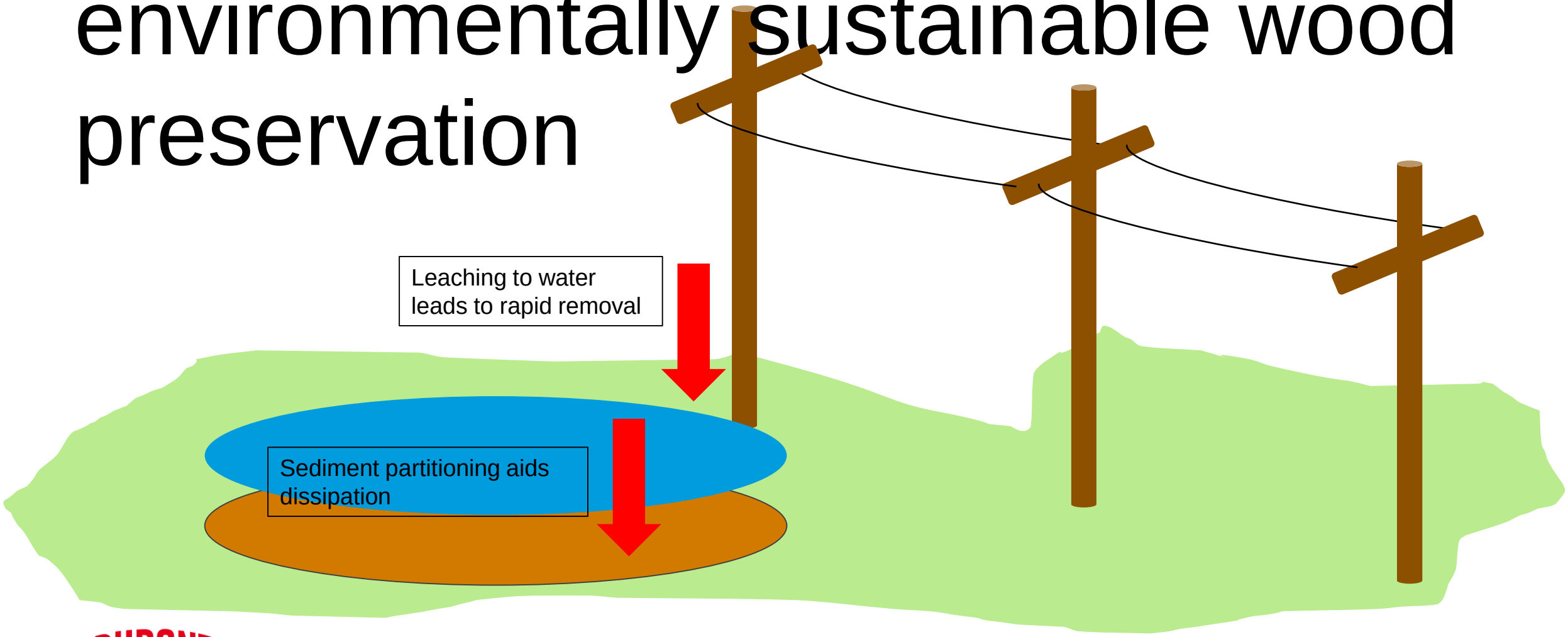

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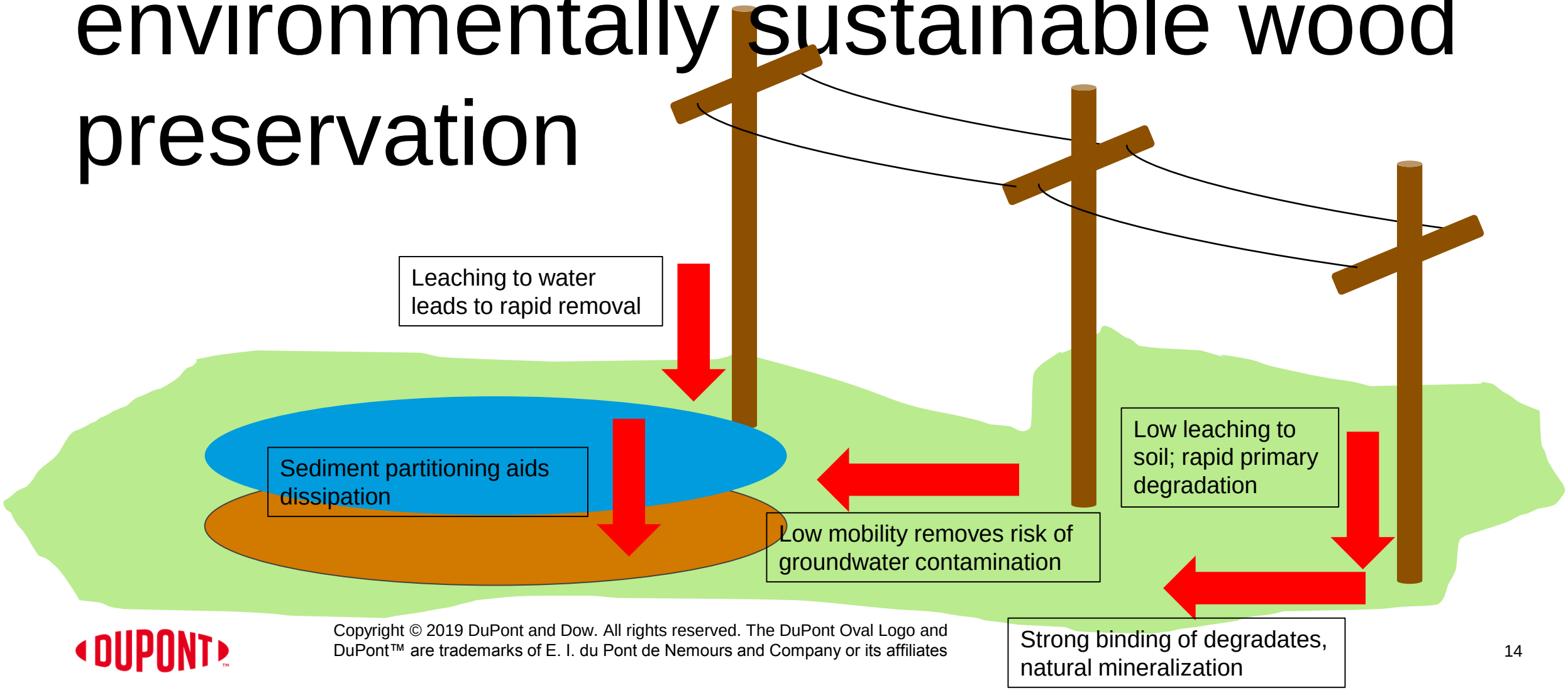

Thank you for your attention